

*Informal note to
be expanded*

An Ice Island Fragment in Stefansson Sound, Alaska

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by

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In late April 1983 a small ice island fragment was found south of . Cross Island, Alaska at the position shown in Figure 1. The ice island was roughly 14 by 17 m on top and about 4 m broader at sea level. As indicated by the orientation of the broken 0.15 to 0.25 m thick ice blocks in the ice rubble field on the west northwest side of the ice island (Figure 2), the island appeared to have been driven aground from this direction. Ten water depth measurements were made around the ice island at locations A through I shown in Figure 3. These measurements indicated a relatively uniform sea bed topography varying between 6.45 to 6.5 m below water level.

An elevation survey gave the maximum sail high of the island to be 8.6 m. The top of the island had a sloping surface and severe melt relief (Figure 4). This topography reduced the average height of the ice island to some what less than 8 m.

On 5 May, a 5.5 cm diameter hole was drilled through the ice island at position X and Z (Figure 3). At site X (Figure 5) the ice was found to be 13.9 m thick and at site Z it was 15.05 m thick. Upon drilling through the ice island at each site, the drill immediately encountered the silty sea bed material. This material was penetrated to a depth of 0.1 m at site X and 0.05 m at site Z. The elevation of hole X was at 7.2 m and at site Z it was 8.35 m. From these measurements it was determined that the ice island keel had a draft of 6.7 m. This draft indicates that the ice keel had gouged into the sea bed 0.2 to 0.25 m when driven aground.

Sea water was found to enter each of the drill holes at a slow rate. At hole X, four hours after it was drilled, sea water had risen 5.5 m in the hole or to an elevation 1.2 m below sea level. Three days later on 8 May an ice plug had formed in the hole at a depth of 0.9 m below sea level. About 0.1 m of brine was found on top of the ice plug. This brine was apparently forced upward during freeze back of the sea water which had entered the hole. No sample of the brine was obtained but the temperature of the brine in the hole was found to be -7°C . To prevent freezing at this temperature, the brine salinity would have had to be about 160%.

Three hours after the hole at site Z was augered through the ice island sea water had risen 5.8 m in the hole or to an elevation 0.9 m below sea level. In this hole was installed a thermocouple string along which the thermocouples were positioned at 1 m increments. Thermocouple measurements were made four days later and are shown in Figure 6. From this graph it appears that the coldest ice was about -18°C located at a depth of 4 1/2 m below the ice surface.

Both vertical and horizontal ice cores were obtained from the ice island and shipped to CRREL for salinity, density, fabric and unconfined compressive strength determinations. An example of the highly bubbly ice and the annual growth layers in the ice island are shown in Figure 7.

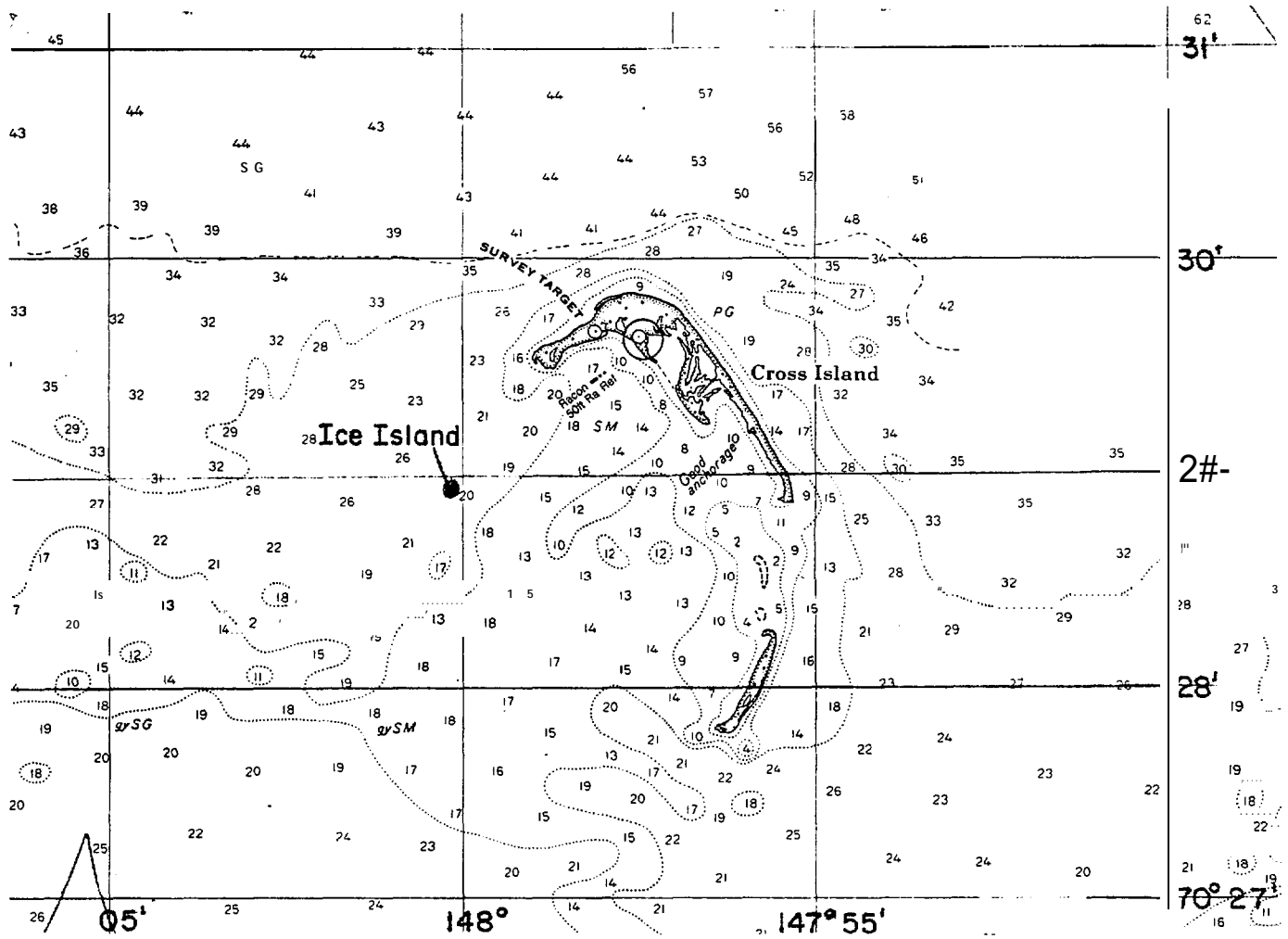


Figure 1. Location of grounded ice island fragment to Cross Island, Alaska.

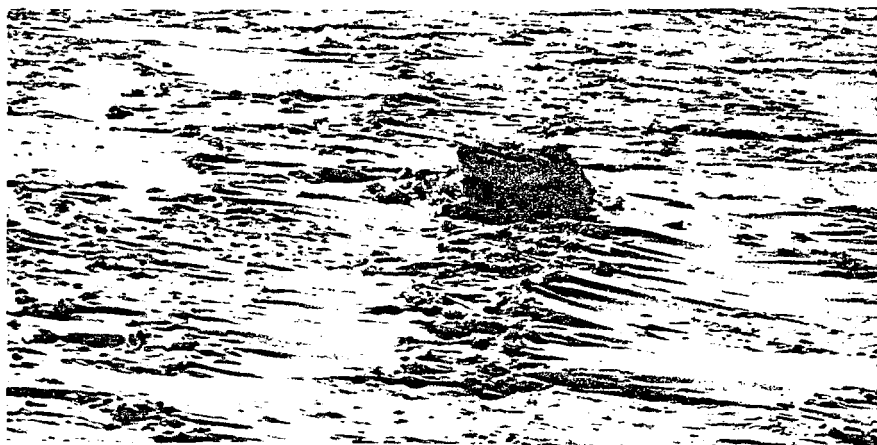


Figure 2. Broken ice block rubble on west northwest side of ice island.

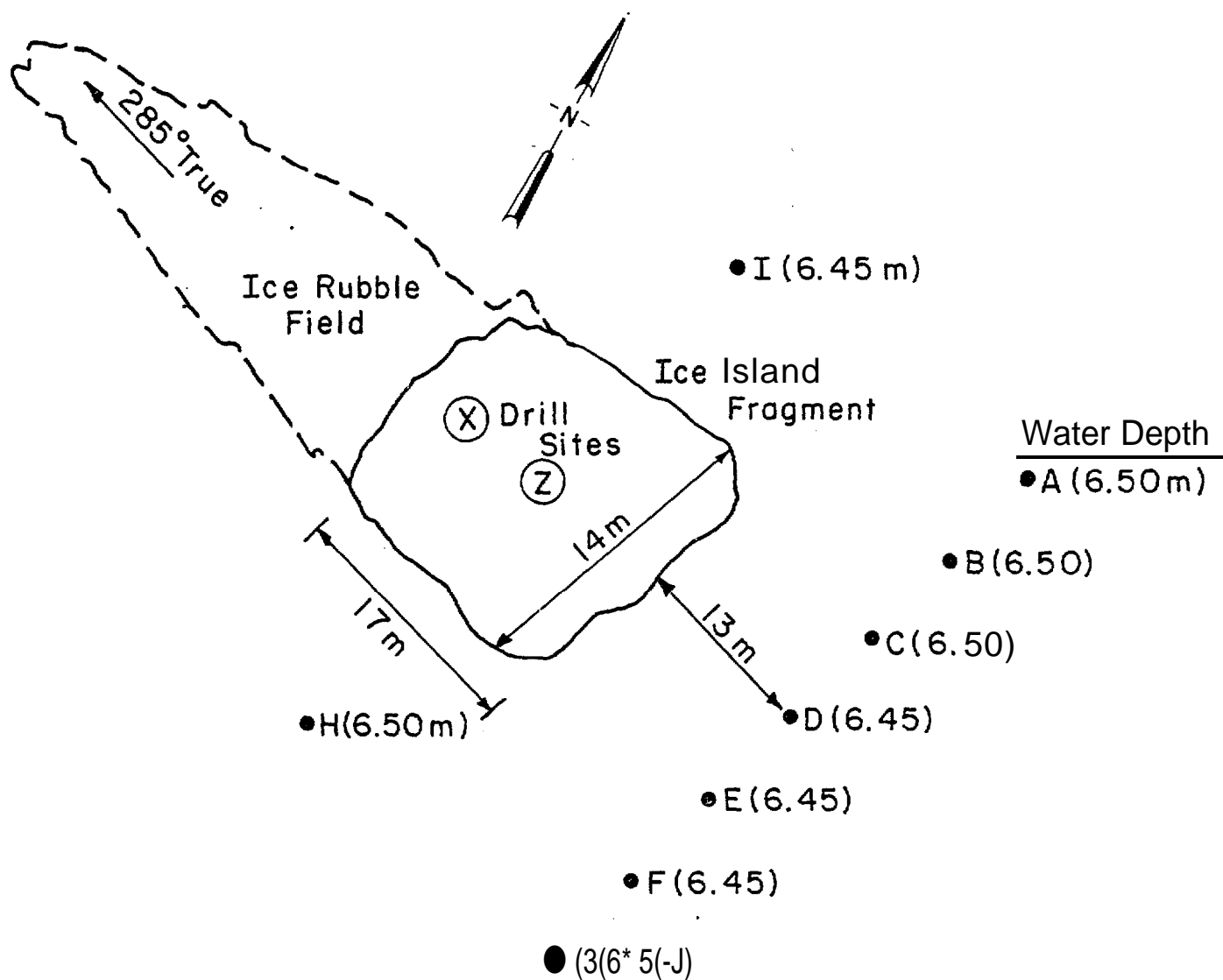


Figure 3. Water depth locations A through I and ice island drill hole sites.



Figure 4. North side of ice island. Saw tooth ice melt relief can be seen on the top left side of island. Note the many parallel layers in the ice. This is a typical feature found in ice islands and is the result of annual growth or accumulation.



Figure 5. Drilling with stainless steel auger flight at site X located in a depression on top of the ice island. Dark area at top of photo is a man made exploration gravel island constructed on the south west end of Cross Island.

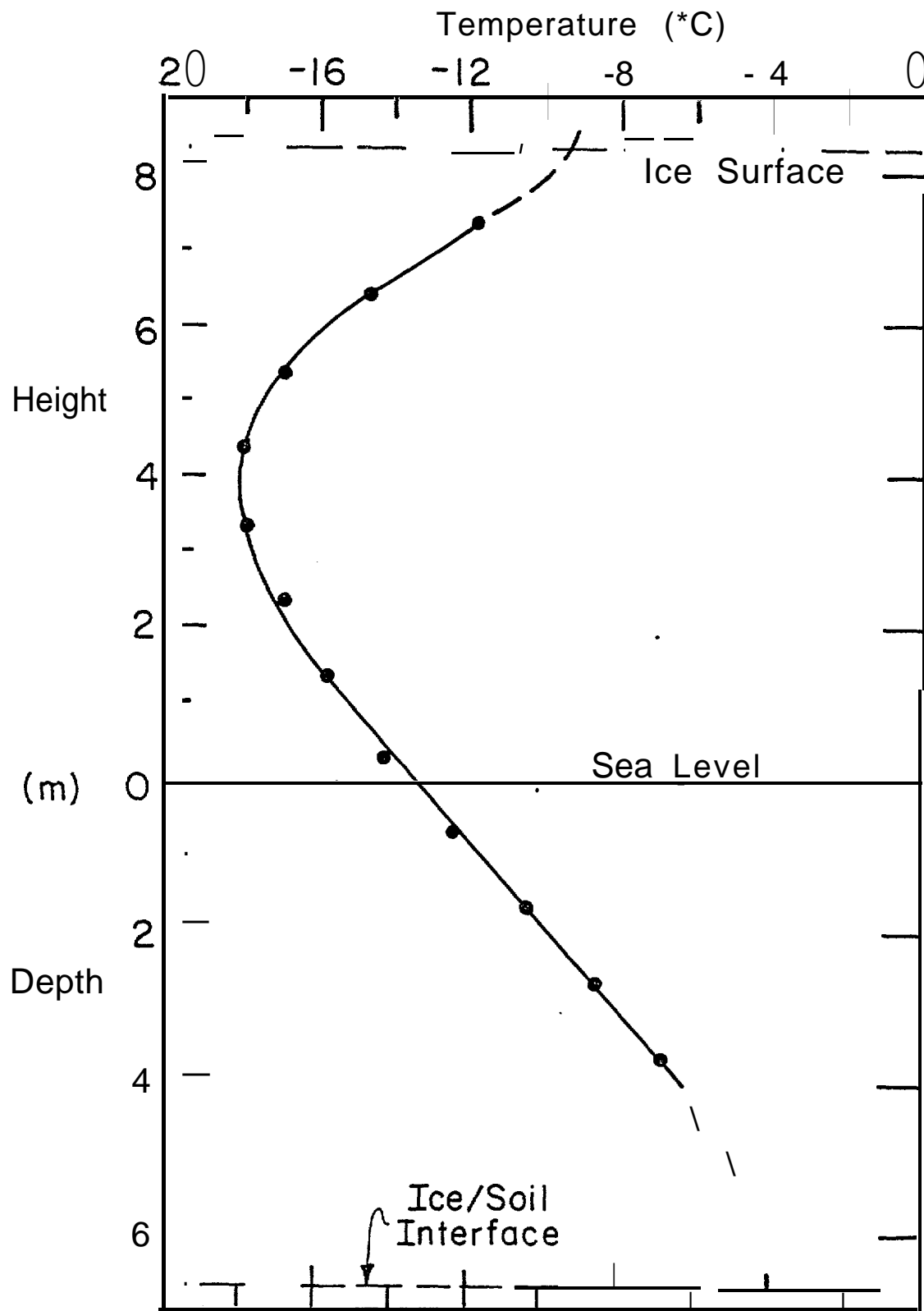


Figure 6. Temperature profile through ice island at site Z.

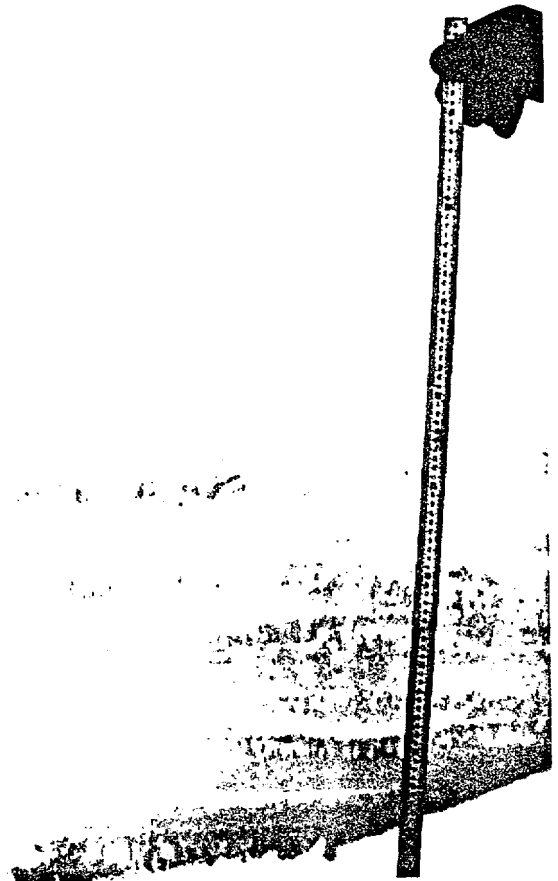


Figure 7. Horizontal layers and bubble structure in the ice island ice.